

Fuels

Program Mission

The mission of the Fuels program is to create public benefits by conducting the research necessary to promote the transition to a hydrogen economy. Research will target reducing costs and increasing efficiency of derived hydrogen from coal feedstocks as part of the Freedom Fuel Initiative.

Currently, the United States imports approximately 11 million barrels per day of petroleum crude and finished products (55% of consumption). By 2020 imports are projected to rise to 17.5 million barrels per day of crude and refined products (67% of consumption). Coal-derived hydrogen can be an important part of a strategy to diversify and expand our domestic fuel resource base, reduce emissions from the transportation sector, and help limit our reliance on imported oil.

In addition to energy security issues, major challenges facing transportation are urban and regional air pollution and emissions of greenhouse gases. EIA 2000 data indicates that of man-made emissions, the U.S. transportation sector is responsible for nearly 80 percent of the carbon monoxide (CO), over one half of the nitrogen oxides (NO_x), and 40 percent of the volatile organic compounds (VOC). Vehicles are responsible for about 35% of the U.S. energy sector's carbon dioxide production. As the Nation transitions toward advanced engine platforms, ultra-low emission vehicles and eventually to near-zero emission vehicles, such as the Administration's recently announced fuel cell-powered "FreedomCAR", the demand for hydrogen will increase dramatically. Our large domestic resources of coal can provide high volume, low-cost, ultra-pure hydrogen for fuel cells in the longer term.

Research will address the development of technologies to produce, distribute and store hydrogen as an affordable, safe fuel for consumers. Specifically, this research activity will encompass a technology envelope that begins with the separation of hydrogen from mixed gas streams and conclude with the interface of the hydrogen with fuel cells and other end-use systems. In FY 2004, research will target the development of technologies (1) capable of economically producing large quantities of pure hydrogen from coal-derived synthesis gas, (2) capable of safely and economically storing, distributing and handling hydrogen derived from coal gasification processes for end-use in the utility, transportation, commercial, industrial and residential markets, and (3) that will enable hydrogen from coal feedstocks to play a major role in the transition to sustainable hydrogen based energy systems.

Centralized production of hydrogen from coal feedstocks will produce a concentrated stream of carbon dioxide which will facilitate its economic capture and sequestration. There are two routes to supplying hydrogen from these advanced coal gasification facilities. A portion of the hydrogen can be separated from the mixed gas stream (i.e. synthesis gas) which is produced during the gasification process and then stored for distribution. The other alternative is to produce, via synthesis gas conversion processes, zero-sulfur, high hydrogen content coal-derived fuels that can be moved through the present distribution system, then reformed at facilities in close proximity to the customer or directly on-board the vehicle.

Program Strategic Performance Goals

The Fuels Program supports Strategic Objective ER-4 through Program Strategic Performance Goal (PSPG) ER4-2 as well as through the development of other technologies not currently covered under a PSPG. To aid in the management and performance tracking of the Fuels Program, a set of annual goals, along with a Midterm Performance Goal, which is equivalent in scope to a PSPG has been developed. It is:

Performance Indicator

- By 2010, complete development of modules capable of co-producing hydrogen from coal at \$30/barrel crude oil equivalent (no incentives or tax credits) when integrated with advanced coal power systems.

Annual Performance Targets and Results

FY 2002 Results	FY 2003 Updated Targets	FY 2004 Targets
Complete laboratory scale test operations of novel ITM-syngas ceramic membrane reactor to reduce gas-to-liquid fuel conversion costs. (Met goal)	<p>Complete development and communication of a hydrogen program and implementation plans.</p> <p>Continue development of ITM membrane technology at reduced pace leading to the scaleup of the concept at the SEP level.</p>	Implement a coal derived hydrogen program by conducting a solicitation to identify at least two organizations (projects) to establish the feasibility of emerging alternate coal-based hydrogen technologies including advanced separations.

Funding Profile

(dollars in thousands)

	FY 2002 Comp. Approp.	FY 2003 Request	FY 2004 Base	FY 2004 Request	FY 2004 Request vs. Base	
					\$ Change	% Change
Transportation Fuels and Chemicals	\$25,002	\$5,000	\$5,000	\$5,000	\$0	0.0%
Solid Fuels and Feedstocks	4,896	0	0	0	0	0.0%
Advanced Fuels Research	3,916	0	0	0	0	0.0%
Total, Fuels	\$33,814	\$5,000	\$5,000	\$5,000	\$0	0.0%

Funding by Site

(dollars in thousands)

	FY 2002	FY 2003	FY 2004	\$Change	%Change
Los Alamos National Laboratory	\$100	\$200	\$0	\$-200	-100.0%
National Energy Technology Laboratory	4,050	1,280	0	-1,280	-100.0%
Pacific Northwest National Laboratory	150	0	0	0	0.0%
All Other	29,514	3,520	5,000	1,480	42.0%
Total, Fuels	\$33,814	\$5,000	\$5,000	\$0	0.0%

Site Description

Los Alamos National Laboratory

The Los Alamos National Laboratory (LANL), located in Los Alamos, New Mexico, is conducting research on a novel thermo-acoustic natural gas liquefaction process that requires no electric power to product LNG. The liquefier energy is provided by the combustion of a portion of the natural gas feed.

National Energy Technology Laboratory

The National Energy Technology Laboratory (NETL), located in Morgantown, West Virginia, Pittsburgh, Pennsylvania, and Tulsa, Oklahoma, is a multi-purpose laboratory, owned and operated by the U.S. Department of Energy. NETL conducts and implements science and technology development programs for the Department in energy and energy-related environmental systems. NETL's fuels research is focused on developing technologies to reduce the costs of producing and storing coal-derived hydrogen. Specifically: 1) a unique facility has been established to test materials capable of separating hydrogen from mixed gas streams; 2) catalytic membranes are being developed to enhance the reaction of carbon monoxide with water to produce hydrogen; 3) computational methods are being used to optimize the separation of hydrogen from coal-derived liquids; and 4) novel carbon materials are being tested to safely store hydrogen at high density.

Pacific Northwest Laboratory

The Pacific Northwest Laboratory (PNNL), located in Richland, Washington, is conducting research to develop sealing materials and technology which are needed for the development of ceramic membrane modules for gas separation required to cheaply produce synthesis gas and hydrogen.

All Other

The Department's Fuels Program, within the Fossil Energy and Development program, funds research at major performers at non-DOE locations. Examples of these performers include APCI, Texaco and Praxair.

Detailed Program Justification

(dollars in thousands)

	FY 2002	FY 2003	FY 2004
Transportation Fuels and Chemicals	25,002	5,000	5,000

This program conducts laboratory and process research to develop advanced technology for producing ultra clean fuels and hydrogen from coal by use of gasification technology possibly with coproduction of electricity and other products. Because of budget priorities funding is requested for only longer-term hydrogen research.

■ Reactor/Process Development	1,950	0	0
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No funding is requested for this activity in FY 2004.

No funding was requested in FY 2003. FY 2002 funding maintained and conducted facility upgrading of an alternative fuels facility for production of synthesis gas liquid fuel products. Continued slurry F-T reactor design data base activity. Also, continued feasibility study, R&D, and design of the Early Entrance Coproduction Plant with industry consortium with prior year funding. *Participants included: APCI, WMPI, Texaco.*

■ Systems Engineering	250	0	0
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No funding is requested for this activity in FY 2004.

No funding was requested in FY 2003. FY 2002 funding continued technical, economic, and environmental analyses. *Participants included: Mitretek, Rand, NETL.*

■ Syngas Membrane Technology	6,413	4,950	0
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This activity will be continued within the oil and gas programs.

FY 2003 and FY 2002 funding continued exploratory research activities of novel conversion concepts of promising chemical and small-scale physical conversion technology innovations. Continued research and development of a novel syngas ceramic membrane technology to enhance Fischer-Tropsch (F-T) gas conversion for environmentally superior liquid fuels and hydrogen. Conducted fundamental supporting fuels research at NETL. *Participants included: APCI, NETL, LANL, Univ. Of Alaska, Canmet, Praxair.*

■ Ultra Clean Fuels	16,149	0	0
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In FY 2004, no funds are requested and ultra-clean natural gas and petroleum feedstock projects will be transferred to the oil and gas programs.

FY 2003 funding continued cost-shared industrial research for the development of ultra-clean fuels technology for fossil resources (natural gas, petroleum, coal) using prior year funding. FY 2002 funding continued cost-shared industrial research for the development of ultra-clean fuels technology for fossil resources (natural gas, petroleum, coal). Conduct ultra-clean diesel fuels

research. *Participants included: Praxair, ICRC/Syntroleum, Conoco, RTI, Petrostar, Envires, University of Alaska, NETL.*

(dollars in thousands)

FY 2002	FY 2003	FY 2004
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■ **Hydrogen from Coal Research** 0 0 4,950

Initiate hydrogen from coal initiative by competitive procurement. Identify appropriate organizations to (1) establish the feasibility of emerging alternate coal-based hydrogen technologies, (2) investigate advanced separation technologies, and (3) utilize a combination of experimental and advanced computational methods to determine optimal reaction chemistries for producing hydrogen from coal-derived fuels. *Participants include: NETL.*

No funding was requested in FY 2003 and FY 2002 for this activity.

■ **Program Support** 240 50 50

Fund technical and program management support.

Solid Fuels and Feedstocks 4,896 0 0

Research will be undertaken to provide advanced technologies to produce clean high value carbon products from coal such as high purity carbon electrodes and specialty graphite. Composite fuels comprised of coal and waste biomass for greenhouse gas reduction and separation technology for producing additional clean coal from wastes.

■ **Tailored Carbon Feedstocks** 4,846 0 0

No funding is requested for this activity in FY 2004.

FY 2003 funding was used to conduct: 1) technical/economic assessments and laboratory and bench scale research on technologies for the manufacture of carbon products; and 2) conduct research at outside facilities for advanced technologies for premium carbon products from coal via an industry-led and cost-shared consortium using prior year funding. FY 2002 funding was used to: 1) conduct technical/economic assessments and laboratory and bench scale research on technologies for the manufacture of carbon products; 2) conduct research at outside facilities for advanced technologies for premium carbon products from coal via an industry-led and cost-shared consortium; and 3) continued research in the areas of advanced technologies for solid-solid and solid-liquid separations. *Participants included: NETL, Penn State.*

■ **Program Support** 50 0 0

Fund technical and program management support.

Advanced Fuels Research 3,916 0 0

Provide the scientific underpinning for the development of advanced ultra clean liquid fuels and hydrogen technology from coal.

(dollars in thousands)

	FY 2002	FY 2003	FY 2004
■ Advanced Research	3,884	0	0
No funding is requested for this activity in FY 2004.			
No funding was requested for this activity in FY 2003. FY 2002 funding continued cosponsored investigation of the chemistry of monocarbon compounds (C-1 Chemistry) for the production of hydrogen, syngas, strategic chemicals and transportation fuels with the EE Office of Advanced Automotive Technologies. Investigated advanced extraction concepts for producing advanced extraction products from coal. Conducted fundamental supporting fuels research at NETL. <i>Participants included: NETL.</i>			
■ Program Support	32	0	0
Fund technical and program management support.			
Total, Fuels	33,814	5,000	5,000

Explanation of Funding Changes

FY 2004 vs. FY 2003 (\$000)

Transportation Fuels and Chemicals

■ Decrease in Syngas Membrane Technology due to the conversion of natural gas to synthesis gas activity being transferred to the Oil and Gas programs	-4,950
■ Increase in Hydrogen from Coal Research due to the re-emphasis to longer term objectives with hydrogen from coal, with sequestration being an important avenue for production of abundant hydrogen in an environmentally sound and affordable manner	4,950
Total Funding Changes	0